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WEIGHT AND LONGEVITY.

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The proper selection of lives for a life assurance company is generally considered as coming within the domain of the physician rather than of the actuary. And yet there are few questions on which the statistician cannot throw a little extra light by means of averages and probabilities based on a large number of cases. And this should be and is specially true in all matters relating to insurance, which as a business is entirely based on averages. It is only right, therefore, to expect that even the medical referee may receive valuable hints on several points from the actuarial department, and it is one of these points which I now propose to discuss briefly.

In the early years of the business in Great Britain, it was the custom of many of the companies to compel all applicants to appear personally before the board of directors. The mere certificate of the medical examiner was not considered as sufficient, and the directors wished to see the proposer himself, that they might personally form an opinion as to the risk, from his general appearance. Experience has shown that this precaution was a very desirable one. Mr. Griffith Davies reported, in 1843, that he knew of but one instance in the experience of his company (the Guardian) where the directors had accepted a life which their medical man had pronounced doubtful, but that he had on the other hand known many cases where they had rejected lives which had been reported on favorably by the medical examiner. And there was a reason for this. The average physician was formerly, and too often is now, satisfied with assuring himself that the applicant is merely free from disease. He too often loses himself in the details of the examination, and considers that, because he cannot find anything wrong with any of the organs, he should, as a matter of course, give a first-class certificate of health. The non-professional man, on the contrary, is from necessity compelled to

decide on an applicant's present state of health, by his general outward appearance. A man may be entirely free from disease and yet be by no means robust or likely to attain an average longevity. For this reason the precaution adopted by the English companies was unquestionably a very wise one for those times, although of course utterly incompatible with the requirements of an extended business. In these days a personal appearance at the head office is of course, in the vast majority of cases, entirely out of the question, and the only point now open for discussion is, How can this lack be best made up by the companies? I believe that this can be partially done by paying greater attention than is usually given to the relation between height and weight. It is true that there are a great many persons under the standard weight, to even a considerable extent, who may yet have a thoroughly robust appearance, but it is nevertheless true that as a class those who are much under the average weight for their height are proportionately lacking in vigor. The cases when this is not so are the exceptions to the rule.

The most recent discoveries in medical science add fresh importance to this question. Consumption as a disease is due to the presence of bacilli in the system. Where there are no bacilli there is no consumption, and it is claimed that the vast majority, if not all, of those who attain manhood or womanhood were free from bacilli at birth, even though they subsequently succumbed to the disease. It is now pretty generally admitted that consumption itself is but rarely inherited, being usually the result of infection. What is inherited is a peculiarity or weakness of constitution which renders the system unable to resist the influences to which it is exposed. There are immense numbers of tubercular germs floating around like those of many other diseases, and wherever they find a suitable soil they take root and grow. On a robust constitution they will usually fail to obtain a hold, but any feebleness is apt to supply the needed ground. Since the mere fact of being much under the average weight is in itself usually a proof of some such weakness of constitution, it requires no argument to show how much importance should be attached to this question by life assurance companies. And that this connection between light weight and consumption is no mere theory has been abundantly proved, as will be hereafter shown.

For the discussion of the matter it is evident that the first point to be settled is a correct standard by which applicants can be judged.

Tables of model weights, based on various theories, have been prepared. The usual supposition is that the weight and bulk of a man increase as the cube of his height, the formula being: weight in pounds = $\frac{(\text{height, in inches})^3}{2,000}$.

This is an ingenious supposition, and the results come very near to the truth, but no mere supposition is as satisfactory as a record of actual facts, if that can be obtained. An average based on the experience of a life assurance company itself is preferable to any theory, however carefully devised. Believing this, the writer some years ago compiled a table for the guidance of his own company from the figures contained in two thousand of its own accepted applications, taken in numerical order. The result is given below. For the sake of comparison there are placed beside it the corresponding figures from the theoretical table mentioned above, and also from that known as the "American Standard."

STANDARD WEIGHT.

Height.	True Standard.	Theoretical Standard.	"American Standard."
5 ft. 1 in.	125 lbs.	113 lbs.	120 lbs.
5 " 2 "	128 "	119 "	125 "
5 " 3 "	131 "	125 "	130 "
5 " 4 "	134 "	131 "	135 "
5 " 5 "	137 "	137 "	140 "
5 " 6 "	141 "	144 "	143 "
5 " 7 "	146 "	150 "	145 "
5 " 8 "	151 "	157 "	148 "
5 " 9 "	156 "	164 "	155 "
5 " 10 "	161 "	172 "	160 "
5 " 11 "	167 "	179 "	165 "
6 " 0 "	173 "	187 "	170 "

From an examination of the above it will be seen that the results obtained by the theoretical formula differ materially from the actual facts. Short men are, on the average, heavier than the theory would show; while tall men are, as a rule, lighter. This would indicate that the assumption that the increase in breadth and general development proceed in exact ratio to the increase in height is incorrect. On the other hand, the so-called "American Standard" comes very close to the mark, although it has evidently been prepared somewhat arbitrarily.

Tables prepared from the actual measurements of bodies of men will naturally be liable to any special features which may characterize the class under examination. It is, therefore, desirable that the standard to be used by a life assurance company shall be one based on that section of the population from which its business is drawn. For instance, a table prepared by Mr. Greenleaf from recruits accepted for the United States Army during the last three years gives weights which average from seven to ten pounds below those shown by applicants for life assurance. The reason is easily seen. The age of recruits is much under that of applicants for policies, and the table is, therefore, valueless for life assurance purposes. It represents the average weight of immature young men, and not of those in middle life.

The influence of age on weight is very important, as may be seen by the following analysis of the two thousand policy-holders already mentioned.

AVERAGE WEIGHT AT VARIOUS AGES.

Ages.	Weight.
16 to 20	142 lbs.
21 " 25	149 "
26 " 30	153 "
31 " 35	157 "
36 " 40	158 "
41 " 45	159 "
46 " 50	163 "
51 " 55	168 "
56 " 60	172 "

The above throws into relief several interesting features. The weight of the average healthy man is seen to increase rapidly until about age 35, to remain comparatively stationary for the next ten years, and then to advance steadily again until age 60. What course it follows after that age we have no means of tracing, as the data are too few. It will thus be seen that from 20 to 60 the weight increases on the average thirty pounds, or three-quarters of a pound per annum, although the increase is not evenly distributed. A young man may be considerably under the average for his height and yet be perfectly healthy, but the same deviation from the standard in the case of an older person would be very suspicious. Persons between 16 and 20

are usually about thirteen pounds under the average, those between 21 and 25 about six pounds under it, and those between 26 and 30 about two pounds under it; while those between 31 and 40 are slightly over it, and those of higher ages considerably above it, those between 56 and 60 being as much as seventeen pounds beyond the average.

The influence of occupation has next to be considered. The following shows the main results obtained from a re-classification of the same cases :—

AVERAGE WEIGHT OF PERSONS ENGAGED IN VARIOUS OCCUPATIONS.

Occupation.	Weight.
Tailors.....	145.1 lbs.
Clerks and Salesmen.....	147.1 "
Shoemakers and Saddlers.....	148.0 "
Druggists.....	148.1 "
Laborers.....	148.3 "
Manufacturers.....	151.1 "
Founders and Moulders.....	151.3 "
Teachers.....	151.4 "
Carpenters, Coopers, etc.....	152.6 "
Machinists.....	153.5 "
Merchants.....	153.7 "
Bankers, Insurance Managers, etc...	154.2 "
Blacksmiths.....	155.4 "
Agents, Brokers, etc.....	156.2 "
Commercial Travellers.....	158.1 "
Barristers, etc.....	160.1 "
Physicians.....	160.6 "
Farmers.....	160.9 "
Masons and Bricklayers.....	162.2 "
Clergymen.....	163.7 "
Hotel-keepers.....	166.7 "
Butchers.....	169.3 "

While examining the above it must not be forgotten that the differences shown are not in all cases due to occupation alone. The average age of persons is not the same in all occupations. For instance, bankers, barristers, and merchants are, as a rule, older than their clerks and salesmen, and are, in fact, as a class, composed chiefly of persons who have graduated from the humbler positions.

Let us now proceed to consider the influence of climate. The cases on which the standard previously mentioned is based were exclusively Canadian. The impression is very general that the average prevailing in the tropics is considerably below this. To test this point

I have had another table of averages prepared, based on applications received from the British West Indian Islands, with the following results :—

AVERAGE WEIGHT OF HEALTHY WHITES IN BRITISH WEST INDIES.

Height.	Weight.	Height.	Weight.
5 ft. 1 in.	125 lbs.	5 ft. 7 in.	144 lbs.
5 " 2 "	128 "	5 " 8 "	149 "
5 " 3 "	131 "	5 " 9 "	154 "
5 " 4 "	135 "	5 " 10 "	160 "
5 " 5 "	138 "	5 " 11 "	166 "
5 " 6 "	141 "	6 " 0 "	173 "

It will be noted that this table agrees very closely indeed with that based on Canadian lives. The average height of British West Indian whites was 5 ft. 8.4 in., and their average weight 153.2 lbs., while the corresponding figures of the Canadian applicants of British extraction were 5 ft. 8.6 in., and 155.0 lbs. The two tables, therefore, practically agree, and the conclusion would appear irresistible that the northern standard is a fair one for West Indian whites also. An examination of the question of age, however, shows that the average age of these cases exceeds that of the Canadians, and that the standard weight is not reached in the West Indies till a little later in life than in the north. It follows, therefore, that a somewhat greater laxity may be quite allowable there in the case of young lives.

The above observations on West Indian lives have been confined to the white population. A comparison with mulattoes and blacks may be interesting.

British West Indies.	Height.	Weight.
Average of white applicants, . . .	5 ft. 8.4 in.	153.2 lbs.
Average of mulatto applicants, . . .	5 " 8.0 "	149.2 "
Average of black applicants, . . .	5 " 7.6 "	154.0 "

It will be seen that as regards height the mulattoes, as might be expected, occupy a middle position between the whites and blacks, but in regard to weight they are below both. The proportion of declined cases among the mulattoes (not included above) was, moreover, nearly double that among either whites or blacks. It is, perhaps, a little surprising that the weight of the blacks should be a trifle in excess of that of the whites, but it must be remembered that those blacks who are in sufficiently good circumstances to assure their lives

are apt to be over the average age, and also, perhaps, to a certain extent, picked men physically.

There are certain national characteristics worth noting.

National Characteristics.

Average of British Canadians, . . .	5 ft. 8.6 in.	155.0 lbs.
Average of French Canadians, . . .	5 " 7.3 "	149.9 "
Average of British West Indian whites, 5 "	8.4 "	153.2 "
Average of Spanish West Indian whites, 5 "	6.6 "	144.4 "

The number of female applicants was hardly sufficient to form a thoroughly reliable basis, but as far as they went they agreed almost exactly with the standard for male lives.

In the "Mortuary Experience of the Mutual Life of New York," published in 1877, by Drs. Winston, Gillette, and Marsh, the influence of light weight on mortality was dealt with at some length. They pointed out that nearly eighty per cent of those who had died of consumption in that company had been under the average weight, as indicated by the "American Standard," at the time for applying for assurance. This is certainly startling, but not necessarily conclusive, since the average age at entry of consumptive cases was probably younger than that of the whole company. But no objection can apply to those who entered between the ages of 30 and 40, since the average weight at those ages should be even a little beyond the standard, and yet it was found that of 227 consumptives who assured between those ages only forty-eight were over the average, while 179, or seventy-nine per cent, were under it. This result is certainly surprising and ominous. The conclusion drawn by the authors was summed up in the following words: "We consider it proved by our tables that a weight below the average is a very suspicious circumstance, as indicating a tendency to consumption, and would advise that all persons presenting such disproportionate figure should be most carefully scrutinized."

The most thorough and practical, and therefore the most valuable, contribution to this phase of the subject is that contained in the experience of the Washington Life Insurance Company, compiled by their actuary, the esteemed secretary of this association, Mr. Pierson, and their medical officer, Dr. J. W. Brannan. I extract a few points.

Those who died from	Average Height.	Average Weight.
All causes, ...	5 ft. 8.2 in.	156.2 lbs.
Consumption, ...	5 " 8.2 "	143.7 "
Other causes, ...	5 " 8.2 "	158.9 "

Although the height was exactly the same in all classes, the consumptive cases were, on the average, 15 lbs. under those who died from other causes.

PROPORTION OF DEATHS FROM CONSUMPTION TO TOTAL DEATHS.

Among those whose weight was	Per Cent
Above standard, ...	5.47
Standard, ...	17.86
Below standard, ...	30.72
Whole company, ...	17.65

In the above classification the standard group included all those whose weight was within five pounds above and five pounds below the "American Standard," while the others included those above and below this class respectively.

The following table shows how great is the importance to be attached to weight in the way of either accentuating or annulling any predisposition towards consumption, either hereditary or personal:—

PROPORTION OF DEATHS FROM CONSUMPTION TO TOTAL DEATHS.

Among those who were	Persons Having Some Tubercular Taint Either in Family or Personal History.	Persons with no Taint Whatever.
Over Standard Weight.....	6.13 per cent.	5.28 per cent.
Standard Weight.....	27.27 "	15.84 "
Under Standard Weight.....	48.39 "	24.21 "
Total.....	28.35 "	14.56 "

It is thus evident that the concurrence of light weight and bad or doubtful family history must be looked upon as a matter of the greatest importance, while, on the other hand, an excess of weight may fairly be looked upon as to a certain extent counterbalancing any taint in the family history, or even in the personal record.

Following up this line of thought, I have had the experience of our own company (the Sun Life Assurance Company of Canada) worked out, with the following results:—

Total number of death claims, ...	491
Those from consumption, 126, or 25.7 per cent.	

This percentage is naturally high owing to the fact that the great majority of the policy-holders are yet young men, and consumption,

of course, forms a much larger proportion of the deaths at those ages than afterwards. We have, moreover, included as consumptive cases a number of deaths which we believe to be really due to that disease, but which in other classifications might have been placed under the names recorded in the certificates, such as "chronic bronchitis," "chronic pneumonia," etc.

	Average Height.	Average Weight.
Consumptive cases, ...	5 ft. 8.6 in.	150.3 lbs.
Non-consumptive cases, ...	5 " 8.6 "	159.6 "
(Not including "respiratory" diseases.)		

Of the 126 consumptive cases there were :—

Standard weight or above, ...	32
Below standard weight, ...	94

Just about 75 per cent (74.6) of all the consumptive cases were thus under the average weight at the time of assuring.

By arranging the cases again into three groups, one including all those whose weight is within five pounds above and five pounds below the true standard, and the two others consisting of those above and below this class, we obtain the following table :—

PROPORTION OF CONSUMPTIVE CASES TO TOTAL DEATHS.

Above standard, ...	14.9 per cent.
Standard, ...	24.1 " "
Below standard, ...	34.3 " "
Whole company, ...	25.6 " "

The next table deals with the question of family history :—

PROPORTION OF CONSUMPTIVE CASES TO TOTAL DEATHS.

Among those who were	Family History Perfect.		Family History Tainted or Doubtful.	
	Number.	Per Cent.	Number.	Per Cent.
Above standard weight	7	8.1	14	22.9
Standard.....	14	15.9	20	42.5
Below standard.....	40	29.0	31	43.7
Whole company.....	61	19.6	65	36.3

These figures speak eloquently as to the influence of a bad or doubtful family history. They also speak with no uncertain voice as

to the effect of light weight in intensifying the danger from any family taint, and of any excess of weight in reducing such danger. They thus confirm strongly the conclusions deduced from the records of the Washington Life, although they, on the other hand, by no means go so far as to promise any practical immunity from consumption to those who are above the average weight, as the experience of that company would seem to indicate. It will, however, be noticed that the number of cases of this kind under observation is very small in both companies, and the probability is that the truth lies between the two conclusions.

Further comment on such figures seems unnecessary. My aim has been to show that the question of weight has a most important bearing on mortality, and is deserving of the most careful attention of all life companies. If I have succeeded, my task is finished.